5-E-43

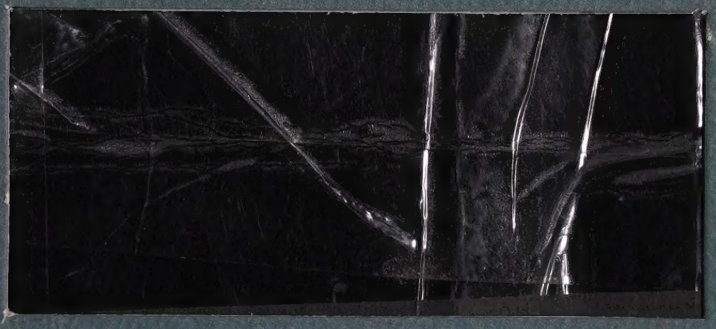
#2901

#185

narda *Microline*®

E 502

INSTRUCTION MANUAL



PRECISION MICROWAVE AND RF TEST EQUIPMENT

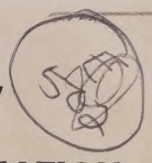
THE NARDA MICROWAVE CORPORATION, PLAINVIEW, L.I., N.Y. 11803 • 516 GE 3-9000

THE NARDA MICROWAVE CORPORATION

TECHNICAL MANUAL
OPERATING AND MAINTENANCE INSTRUCTIONS

FOR

MODEL B86B3/B7
ELECTROMAGNETIC RADIATION MONITOR



TM9-67028-B86B3/B7 Patent No. 3,109,988 September 1967

WARRANTY

THE NARDA MICROWAVE CORPORATION

Warrants each instrument of its manufacture to be free from defect in material and workmanship. The limit of liability under this warranty is to repair and replace any instrument or part thereof which shall, within one year after delivery to the original purchaser, and returned by the orginating purchaser, prove to be defective after examination by us. However, this warranty specifically excludes tubes or transistors, fuses and batteries. Warranty returns must first be authorized by factory office or representative.

The NARDA Microwave Corporation also reserves the right to make changes in design on any of its products without incurring any obligation to make the same changes on units previously purchased.

This warranty is the extent of the obligations or liabilities assumed by The NARDA Microwave Corporation with respect to its instruments, and the NARDA Microwave Corporation neither makes nor authorizes any other person to make any other guaranty or warranty concerning these instruments.

21
19
13
1
1
6

A.

6900

900

TABLE OF CONTENTS

Section		Page
I	GENERAL DESCRIPTION	1-1
	1-1. Introduction	1-1
	1-3. Purpose and Use of Equipment	1-1
	1-8. Equipment Specifications	1-1
	1-10. Equipment Supplied	1-1
	1-12. Principles of Operation	1-1
	1-16. Semiconductor Complement	1-2
II	INSTALLATION AND OPERATION	2-1
	2-1. General	2-1
	2-3. Installation	2-1
	2-5. Unpacking and Inspection	2-1
	2-7. Preoperational Procedures	2-1
	2-11. Operation	2-1
	2-13. Functions of Operating Controls, Indicators and Connectors	2-1
	2-14. Normal Operation	2-1
	2-15. Remote Operation	2-3
	2-16. Battery Charging Procedure	2-4
	2-17. Reshipment	2-5
III	THEORY OF OPERATION	3-1
	3-1. General	3-1
	3-3. Bridge Circuit Operation	3-1
	3-7. Battery Charging Circuit	3-2
IV	MAINTENANCE	4-1
	4-1. General	4-1
	4-3. Preparation for Maintenance	4-1
	4-5. Test Equipment Required	4-1
	4-7. Calibration and Performance Test Procedures	4-2
	4-9. General Test Requirements	4-2
	4-10. Calibration Procedures	4-3
	4-18. Troubleshooting Procedures	4-7
V	PARTS LIST	5-1
	5-1. General	5-1
	5-3. Ordering Information	5-1
	5-7. Customer Repair Service	5-1

LIST OF ILLUSTRATIONS

Figure	Title	Page
1-1.	Narda Microline Model B86B3 Electromagnetic Radiation Monitor	1-0
2-1.	Radiation Monitor, Outline Dimensional Drawing	2-2
2-2.	Remote Measurement Setup	2-3
2-3.	Monitor Operating Controls, Indicators and Connectors	2-4
3-1.	Radiation Monitor, Schematic Diagram	3-1
4-1.	Radiation Monitor, Internal View	4-3
4-2.	Calibration Test Setup for 2.0 to 4.0 GHz Frequency Range	4-5
4-3.	Calibration Test Setup for 5.4 to 8.0 GHz Frequency Range	4-5
4-4.	Calibration Test Setup for 8.2 to 12.4 GHz Frequency Range	4-5
4-5.	Calibration Test Setup for 500 MHz to 1.0 GHz Frequency Range	4-6
4-6.	Calibration Test Setup for 1.0 to 2.0 GHz Frequency Range	4-6

LIST OF TABLES

Table	Title	Page
1-1.	Equipment Specifications	1-2
2-1.	Functions of Operating Controls, Indicators and Connectors	2-3
4-1.	Test Equipment Required for Maintenance	4-1
5-1.	Replaceable Parts List	5-1

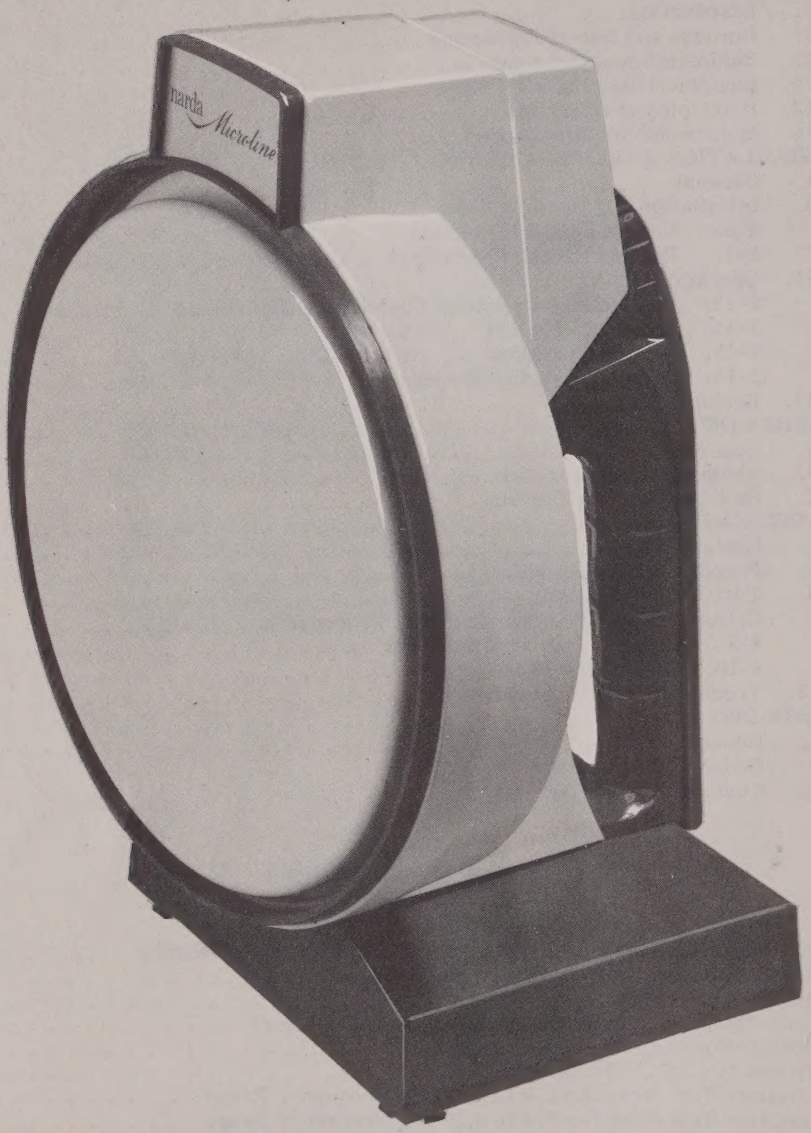


Figure 1-1. Narda Microline Model B86B3 Electromagnetic Radiation Monitor

SECTION I

GENERAL DESCRIPTION

1-1. INTRODUCTION.

1-2. This manual provides instructions for the use and maintenance of the Narda Microline Models B86B3 and B86B7 Electromagnetic Radiation Monitors, designed and manufactured by the Narda Microwave Corporation, Plainview, Long Island, New York. The manual includes a general description of the equipment, installation and operating instructions, theory of operation, maintenance data and a replaceable parts list.

1-3. PURPOSE AND USE OF EQUIPMENT.

1-4. The Narda Microline Model B86B3 Electromagnetic Radiation Monitor (figure 1-1), is a portable, battery-operated precision instrument designed for rapid, simple detection and indication of radiated fields emanating from high power microwave sources in radar and communications work. The Monitor, in detecting electromagnetic power density throughout the 0.45 to 12.4 GHz frequency band, ensures personnel safety in the proximity of these high power microwave sources. The Narda Microline Model B86B7 was specifically designed for industrial use, such as microwave ovens, and covers one of two frequency ranges, 915 MH_Z or 2450 MHz as chosen by the Frequency Select switch on the left side of the instrument.

1-5. The Monitor presents a 7-inch diameter antenna aperture to the radiation field, which responds to all planes of polarization; linear left- and right-hand circular, random, pulsed or continuous wave. All energy incident upon the antenna is integrated, and total field density is read directly on the output meter which is calibrated in mw/cm^2.

1-6. The instrument is housed in a high-impact plastic case with integral handle. A combined On-Off-Zero adjust knob is used to zero the meter before exposing the Monitor to an r-f field. A correction factor chart, calibrated at 13 discrete frequencies within the operating bandwidth for Model B86B3, is supplied with each instrument and facilitates interpolation of actual field density in mw/cm^2 as read on the output meter. A recorder output jack is also provided for remote readout of field density on an external meter or recording device. When remote readout is desired, the instrument meter is bypassed.

1-7. In addition to its use as safety equipment, the Monitor offers a rapid, accurate means for checking leakage at transmitter and antenna couplings, and for fast measurement of transmitted power at specified distances from an antenna. Since the unit is battery-powered and easily operated with one hand, it can be readily used in difficult access locations such as antenna towers and shipboard antenna installations.

1-8. EQUIPMENT SPECIFICATIONS.

1-9. Table 1-1 provides a listing of pertinent electrical and mechanical specifications for the Monitor.

1-10. EQUIPMENT SUPPLIED.

1-11. The Monitor is supplied with an integral 3-foot line cord used for battery charging; the line cord is stored in the base of the instrument. Optional equipment includes an instrument carrying case.

1-12. PRINCIPLES OF OPERATION.

1-13. To effectively monitor radiated energy over a broad bandwidth, several antennas would be required, since each antenna usually covers less than one octave in frequency. Consequently, it becomes necessary to make a series of radiation measurements employing each antenna, in turn, in order to determine total energy in a given frequency range. In addition, conventional monitors are usually sensitive to linear polarization of only one orientation. As a result, it becomes necessary to rotate the antenna axially in order to align the plane of polarization of the antenna with that of the received energy. If circularly polarized radiation is encountered with such devices, the measurement can be in error by 3 db.

1-14. The Narda Monitor overcomes the difficulties encountered with previous power density measuring devices through its unique antenna sensing circuit. The antenna element incorporates four thermistors, two for high frequencies and two for low frequencies, arranged in a bridge configuration. These are positioned on the antenna element so that the total of r-f power absorbed is essentially equal to the total of power in all modes of polarization. Bridge output voltage is measured by a 1.0 ma, 50-millivolt full-scale meter calibrated in milliwatts/centimeter^2.

1-15. In use, the bridge is first balanced by adjusting the Zero control to inject dc current into the bridge, establishing the thermistor resistance at 300 ohms. When the unit is placed in an r-f field, the energy absorbed by the thermistors causes the bridge to be unbalanced, resulting in a meter deflection corresponding to the amount of unbalance. Quantitative measurements of cw or pulsed power density are obtained by multiplying the meter reading by a correction factor provided on the calibration chart. For remote readouts, a remote 50-millivolt full-scale meter movement should be used and its movement should first be calibrated against the monitor meter scale to provide readout in mw/cm^2.

Table 1-1. Equipment Specifications

Safe Power Indication	10 mw/cm^2
Power Range	0.5 to 20 mw/cm^2
Power Accuracy	±1.0 db from 1.0 to 12.4 GH_Z, ±2.0 db from 0.45 to 1.0 GH_Z (with calibration chart)
Frequency Range:	
Model B86B3	0.45 to 12.4 GH_Z
Model B86B7	915 and 2450 MH_Z
Frequency Sensitivity	0 to +5.0 db over range
Battery Data	15-volt nickel-cadmium rechargeable battery
*Recharging Voltage	110 volts, 50 to 60 H_Z
Operating Temperature Range	Ambient temperature range of -4°F to +120°F. Accurate readings may be taken at ambient temperatures as low as -40°F, provided the instrument is first zeroed at normal operating temperatures and then re-zeroed at the lower ambient.
Weight	3.0 pounds (approx)
Dimensions	6-1/2" D x 10-11/32" H x 7-17/32" W

*The instrument battery may be recharged from a 220-volt, 50 to 60 H_Z source with slight modification to the charge circuit.

1-16. SEMICONDUCTOR COMPLEMENT.

1-17. The only semiconductors contained in the Monitor are four type 1N645 diodes, CR1 through CR4, which form the battery-charging bridge rectifier circuit.

SECTION II

INSTALLATION AND OPERATION

2-1. GENERAL.

2-2. The Monitor is shipped complete and ready to operate; no special installation procedures are required unless a fixed station or system type of installation is contemplated. The instrument should be carefully unpacked and inspected upon receipt; observe the usual precautions necessary when unpacking an electronic instrument.

2-3. INSTALLATION.

2-4. The following paragraphs describe procedures required to unpack, inspect and set up the instrument prior to operation. An outline dimensional drawing of the Monitor is presented in figure 2-1.

2-5. UNPACKING AND INSPECTION. Upon receipt of the Monitor, perform a preliminary visual inspection of the container for evidence of damage during transportation. Any evidence of serious damage should be reported to the carrier prior to unpacking the equipment. If there is no evidence of damage, unpack the instrument following conventional unpacking procedures and using care.

NOTE

Keep container and packing materials should reshipment become necessary.

2-6. The Monitor was tested, calibrated and inspected at the factory prior to shipment. Immediately after unpacking the instrument, visually inspect it for damage incurred in transit, such as broken knob, jack, and meter, scratches on case, etc. Following visual inspection, check the Monitor electrically in accordance with the performance test procedure in Section IV of this manual. If there is any evidence of damage, immediately file a claim for damage in transit with the carrier. Packing instructions for reshipment are outlined in paragraphs 2-17 and 2-18.

2-7. PREOPERATIONAL PROCEDURES. The following paragraphs discuss procedures for setting up the Monitor for operation, and for making a minimum performance check.

2-8. Setup for Normal Operation. For normal operation of Model B86B3 no special setup requirements are necessary. Usually the instrument is handheld in the path of the r-f field after proper meter-zeroing has been accomplished. For Model B86B7, the Frequency Select switch is first set to the desired frequency (915 or 2450 MH_Z), the meter is zeroed, and the instrument is then placed in the path of the microwave field.

2-9. Setup for Remote Operation. (See figure 2-2.) For remote operation, the remote-reading meter should first be calibrated against the instrument meter for accurate meter zeroing and measurement of power density in mw/cm^2. After this has been accomplished, connection of the remote meter is made via the Monitor recorder output jack and the Monitor is placed in the path of the r-f field.

2-10. Performance Test. A comprehensive test to assure that the instrument is functioning properly can be made by executing the performance test procedure in Section IV of this manual.

2-11. OPERATION.

2-12. The following paragraphs describe typical operating procedures for the Monitor, including battery use and charging information.

2-13. FUNCTIONS OF OPERATING CONTROLS, INDICATORS AND CONNECTORS. (See figure 2-3.) Operating controls, indicators and connectors for the Model B86B3 are illustrated in figure 2-3 and their functions are described in table 2-1. Model B86B7 contains an additional two-position Frequency Select switch on the left side of the instrument for selection of 915 or 2450 MH_Z operation.

2-14. NORMAL OPERATION. For normal operation of the Monitor, proceed as follows:

CAUTION

When measuring field density at specified distance from radiating source, particularly a high power source, mark off desired distance from source. After zeroing meter at a considerable distance past desired spot, slowly walk toward marked area while noting indication. If indication approaches danger level (10 mw/cm^2) before area is reached, a remote measurement must be made. (Refer to paragraph 2-15.)

a. Point instrument away from r-f energy source and rotate integral On-Off-Zero control knob clockwise. On Model B86B7, set Frequency Select switch to 915 or 2450 MH_Z position.

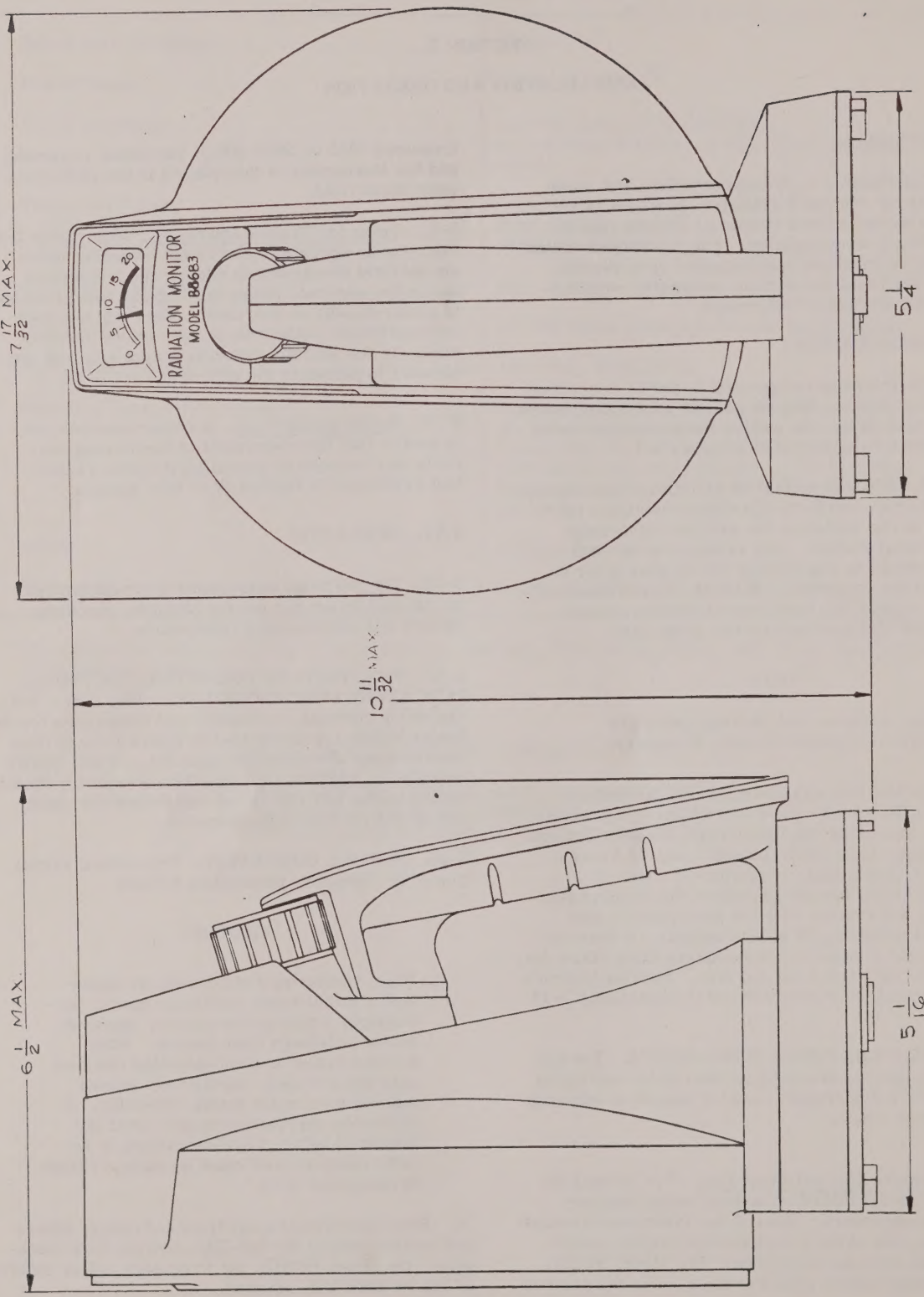


Figure 2-1. Radiation Monitor, Outline Dimensional Drawing

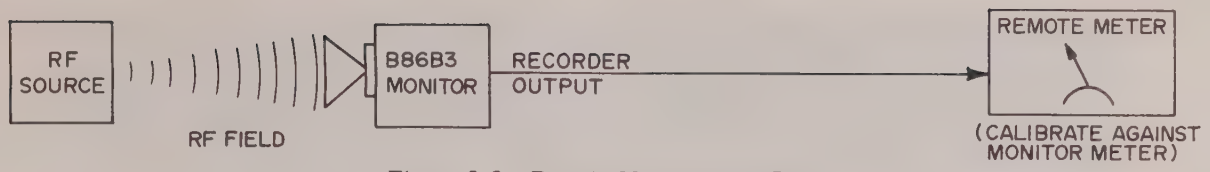


Figure 2-2. Remote Measurement Setup

Table 2-1. Functions of Operating Controls, Indicators and Connectors

Fig. 2-3 Index No.	Control, Indicator or Connector	Function
1.	On-Off switch and Zero control	Provides means of energizing Monitor and zeroing antenna thermistor bridge circuit as indicated on meter.
2.	Meter	Indicates level of r-f field in mw/cm^2 as sensed by antenna. Safe level indicated by green area; red area (10 mw/cm^2) indicates unsafe area. OFF position on scale indicates instrument deenergized.
3.	Recorder Output jack	Phone jack to permit external display of field density on remote meter. When used, instrument meter is bypassed.
4.	Calibration Card (B86B3)	Provides correction factor vs. frequency; meter reading is multiplied by correction factor to obtain accurate measurement.

NOTE

If meter will not zero, or exhibits excessive drift about zero point, recharge or replace battery.

b. Slowly rotate On-Off-Zero control knob clockwise until meter pointer moves; vary control to obtain zero reading.

c. Scan instrument about horizontal and vertical axis until maximum meter reading is obtained. Field density level as indicated on meter is integrated reading of all r-f energy incident upon antenna from that particular direction.

NOTE

To provide an additional safety factor for personnel protection, the Monitor is calibrated so that the actual power density is normally less than the meter indication over the full frequency range.

d. On Model B86B3, multiply meter reading by FIELD DENSITY correction factor for r-f source operating frequency to obtain accurate field density level.

2-15. REMOTE OPERATION. For remote operation of the Monitor proceed as follows:

NOTE

Remote meter must have 1.0 ma, 50 millivolt full-scale movement.

a. Prior to making remote measurement, calibrate remote meter against Monitor meter, including zero adjustment.

b. Set Monitor at desired point in path of r-f field with r-f source deenergized.

NOTE

On Model B86B7 set Frequency Select switch to desired position.

c. Connect remote meter via sufficient cable length to Recorder Output jack on Monitor.

d. Energize Monitor, as before, and zero meter.

e. Energize r-f source and read field density on remote meter.

f. At r-f source operating frequency for Model B86B3, determine correction factor from Monitor chart and multiply remote indication by this value to obtain accurate field density in mw/cm^2.

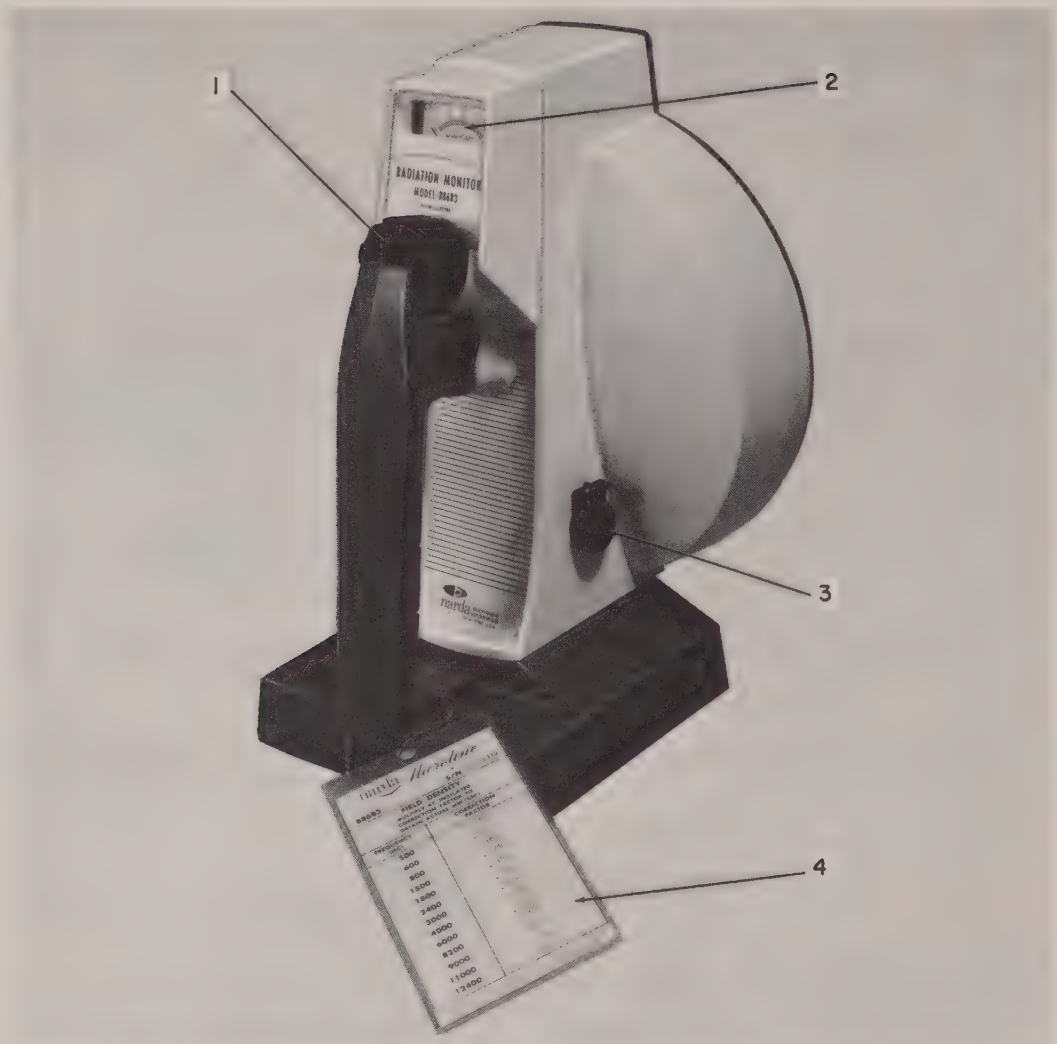


Figure 2-3. Monitor Operating Controls, Indicators and Connectors

2-16. BATTERY CHARGING PROCEDURE. The Monitor battery pack must be recharged when there is excessive meter drift and/or the meter cannot be zeroed. Recharge the nickel-cadmium battery pack as follows:

a. Remove four screws securing cover to pedestal bottom.

CAUTION

Never disconnect batteries during charging cycle or damage to the unit will result.

b. Remove plug end of line cord from bottom of instrument and connect to a standard 110-volt, 50 to 60 H_Z line voltage source.

NOTE

If batteries are being recharged from a 110-volt, 50 H_Z source, the charge time will be approximately 20% longer.

c. Charge batteries for approximately 16 hours.

NOTE

If it is desired to recharge the battery from a 220-volt, 50 to 60 H_Z source, charge capacitor C1 must be changed from a 1.0 uf to a 0.5 uf value. (Refer to Section IV.) If line frequency is 50 H_Z, a 20% longer charge time is required, as before.

2-17. RESHIPMENT.

2-18. If possible, in the event the Monitor was damaged during shipment, or if the instrument requires repair, use the original packing container and materials. If a substitute shipping container is used, make certain it has strong cardboard or wooden sides and heavy wrappings. The Monitor should be surrounded by ample padding when placed in the container. After packing, the container should be clearly marked "FRAGILE" and "DELICATE INSTRUMENT" on the surfaces. Refer to Section V for more detailed shipping instructions.

SECTION III

THEORY OF OPERATION

3-1. GENERAL.

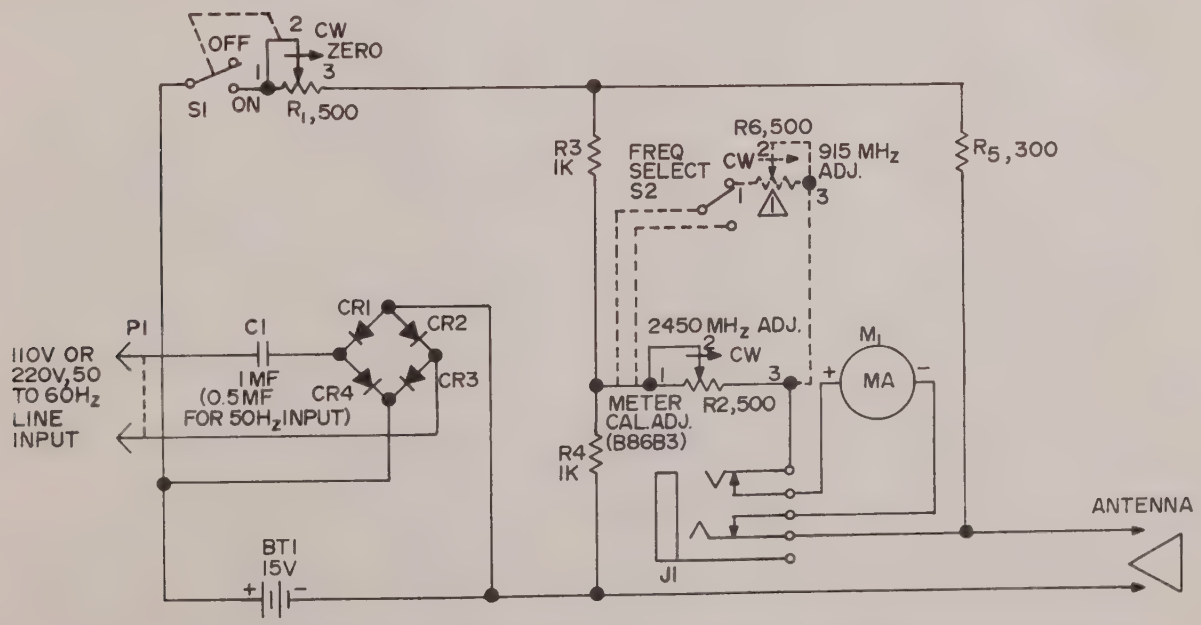
3-2. Due to the small number of components and relative simplicity of operation, the following discussion is based on the schematic diagram, figure 3-1.

3-3. BRIDGE CIRCUIT OPERATION. (See figure 3-1.)

3-4. The heart of the Monitor consists of a bridge circuit, with the series combination of four antenna thermistor elements as one arm of the bridge. The other bridge arms consist of resistors R3, R4, and R5, with the combination of Meter Calibration adjust potentiometer R2. Recorder output jack J1 and meter M1 connected across the bridge. On Model B86B7, Frequency Select switch S2 connects either 915 MH_Z Adjust potentiometer R6 or 2450 MH_Z Adjust potentiometer R2 into the meter circuit.

3-5. In the absence of external monitoring, meter M1 is in the circuit. When the combination On-Off switch S1 and Zero control R1 is activated, current from battery BT1 flows into the bridge causing meter M1 to indicate degree of bridge unbalance. Zero control R1 effectively controls the amount of current through each half of the bridge such that when meter M1 indicates zero or a pre-set bridge unbalance, thermistor resistance is approximately 300 ohms.

3-6. When r-f energy is encountered by the antenna assembly, the resistance of one or more of the thermistors decreases, depending on polarization and intensity of the intercepted field. The net change in total resistance of that arm of the bridge, is then proportional to the intensity of all r-f radiation impinging on the antenna surface. Due to the net change in bridge resistance, an unbalance results which causes a proportional change in bridge current. Thus, the current change causes meter M1 to deflect by an amount corresponding to the intensity of the r-f field. Meter Cal Adjust potentiometer R2 in Model B86B3 provides a means of calibrating the scale of meter M1 to determine proper correction factor vs frequency over the operating bandwidth. In Model B86B7 either 915 MH_Z Adjust potentiometer R6 or 2450 MH_Z Adjust potentiometer R2 provides a means of calibrating the scale of meter M1 at those two frequencies.



IN MODEL B86B7, CALIBRATION ADJUST POTENTIOMETER R6 FOR 915 MHz IS ADDED TO THE CIRCUIT TOGETHER WITH FREQ SELECT SWITCH S2 TO PROVIDE NECESSARY SWITCHING BETWEEN R6 AND EXISTING CALIBRATION ADJUST POTENTIOMETER R2 FOR 2450 MHz. IN MODEL B86B3, ONLY POTENTIOMETER R2 IS PRESENT.

Figure 3-1. Radiation Monitor, Schematic Diagram

3-7. BATTERY CHARGING CIRCUIT.

3-8. The battery charging circuit consists of bridge rectifier diodes CR1 through CR4, capacitor C1, and battery BT1. With line cord plug P1 connected to a 110 or 220-volt, 50 to 60 H_z source, the ac line voltage input is rectified and applied, in the proper polarity, to battery BT1, thereby charging the battery. The value of capacitor C1 must be changed to 0.5 uf if the battery is to be charged from a 220-volt, 50 to 60 Hz line voltage source. When the battery is being charged from a 50 H_z source rather than 60 H_z, a 20% longer charge period is necessary due to the reactance increase of capacitor C1.

SECTION IV

MAINTENANCE

4-1. GENERAL.

4-2. This section provides servicing information and instructions for performing calibration and repair of the Monitor.

CAUTION

Once the antenna assembly is disturbed or disassembled, the calibration data furnished on the FIELD DENSITY correction factor chart is no longer valid, and the instrument must be re-calibrated.

4-3. PREPARATION FOR MAINTENANCE.

4-4. To effectively calibrate or check the operation of the Monitor, the instrument should be placed in an anechoic chamber and connected to a remote readout device such as a null meter. Refer to paragraphs 4-10 through 4-16 for applicable procedures.

4-5. TEST EQUIPMENT REQUIRED.

4-6. Test equipment required to check and/or calibrate the Monitor is listed in table 4-1. Alternate equipment with equal or greater specifications may be substituted.

Table 4-1. Test Equipment Required for Maintenance

Test Equipment	Manufacturer	Use
Anechoic Chamber	Dimensions of at least 6' x 6' x 6'.	Test and calibration of Monitor.
Oscillator	A.I.L., type 125	RF source for low frequency tests.
Low Pass Filter	Narda Model 3010-4200	Calibration from 500 MHz to 4.0 GH_Z.
Temp. Comp. Power Meter	Narda Model 447 (2)	Monitoring of incident and reflected power.
Temp. Comp. Thermistor Mount	Narda Model 480 (2)	Monitoring of incident and reflected power.
Attenuator Pad	Narda Model 757B-20 (2)	Monitoring of incident and reflected power.
Attenuator Pad	Narda Model 757B-10 (1)	Monitoring of incident and reflected power.
Dual Directional Coupler	Narda Model 3020A	Monitoring of incident and reflected power, 500 MHz to 1.0 GH_Z.
Dual Directional Coupler	Narda Model 3022	Monitoring of incident and reflected power, 1.0 to 4.0 GH_Z.
Dual Directional Coupler	Narda Model 3024	Monitoring of incident and reflected power, 5.4 to 8.0 GH_Z.
W.G. Directional Coupler	Narda Model 1080-40	Monitoring of incident and reflected power, 8.2 to 12.4 GH_Z.
W.G. Thermistor Mount	Narda Model 1480	Monitoring of incident power.
Isolator, Coaxial	Sperry Model D44L15	RF line filter, 1.0 to 2.0 GH_Z.

Table 4-1. Test Equipment Required for Maintenance (cont)

Test Equipment	Manufacturer	Use
Isolator, Coaxial	Sperry Model D44S15	RF line filter, 2.0 to 4.0 GH_z.
Isolator, W.G.	Narda Model 1212	RF line filter, 5.8 to 8.2 GH_z.
Isolator, W.G.	Narda Model 1210	RF line filter, 8.2 to 12.4 GH_z.
UHF/VHF Antenna	-	Radiate r-f energy, 500 MH_z to 1.0 GH_z.
Null Meter	H-P 419A	Remote readout of radiated power.
Log Periodic Antenna	A.E.L. Model 101B	Radiate r-f energy, 1.0 to 2.0 GHz.
Standard Gain Horn	Narda Model 644	Radiate r-f energy, 2.0 to 4.0 GH_z.
Signal Source	Narda Model 64S1	Generate r-f energy; 2.0 to 4.0 GH_z.
TWT Amplifier	-	-
Signal Source	Narda Model 64C1	Generate r-f energy, 5.4 to 8.0 GH_z.
TWT Amplifier	-	-
Standard Gain Horn	Narda Model 642	Radiate r-f energy, 5.4 to 8.0 GH_z.
Standard Gain Horn	Narda Model 640	Radiate r-f energy, 8.2 to 12.4 GH_z.
Signal Source	Narda Model 64X1	Generate r-f energy, 8.2 to 12.4 GH_z.
TWT Amplifier	-	-
Radiation Monitor	Narda Model B86B3	Calibrated to NBS standards for comparison test.
Multimeter	Simpson 260	Charge current measurement.
Precision Decade Resistance	-	-

4-7. CALIBRATION AND PERFORMANCE TEST PROCEDURES.

4-8. A total of five test setups are required to accurately calibrate and rate the performance of Model B86B3. (Only two setups are required for Model B86B7.) Each of these setups span a portion of the Monitor operating bandwidth of 0.45 to 12.4 GH_z. In implementing each test setup, the Monitor is accurately calibrated at the following 13 discrete frequencies:

500 MH_z	1500 MH_z	6000 MH_z
600 MH_z	2400 MH_z	8200 MH_z
800 MH_z	3000 MH_z	9000 MH_z
915 MH_z	4000 MH_z	11000 MH_z
		12400 MH_z

NOTE

Model B86B7 is calibrated at frequencies of 915 and 2450 MHz. Refer to paragraphs 4-15 and 4-16.

4-9. GENERAL TEST REQUIREMENTS. The following test requirements are stipulated for the Monitor:

a. The instrument shall be tested with an incident power density of 2 mw/cm^2 indicated.

b. Qualitative tests shall be made to assure linearity of power density readings as a function of power density.

c. Instruments shall be tested in both the horizontal and vertical polarization positions.

d. Total spread of readings at all frequencies and both polarizations shall not exceed 5 db (3.16 to 1.0 power ratio).

WARNING

Calibration setting of meter calibration potentiometer(s) within the Monitor shall be made so as to produce an ultra-safe indication; that is, in no instance shall the indicated power density reading be less than the actual power density incident upon the antenna. This corresponds to adjusting the potentiometer to read correctly for the lowest obtained meter (power density) indication on the particular unit, providing conditions in step d. are met.

e. The Test Data Record sheet must reflect specific frequency at which sensitivity calibration was made and all readings obtained for each instrument.

f. A calibration curve showing indicated vs incident mw/cm^2 shall be provided for each instrument.

4-10. CALIBRATION PROCEDURES. Calibration and performance test procedures for the Monitor are divided into two groups: The first is a general procedure for determining the calibration factor for each test frequency above 2.0 GHz; and the second is the calibration test procedure at frequencies from 500 MHz to 2.0 GHz. Figure 4-1 illustrates an internal view of the Monitor.

NOTE

No calibration factor data is provided with Model B86B7 since calibration is performed at only two specific frequencies.

4-11. Determining Calibration Factor. The calibration factor to be supplied at each of the test frequencies above 2.0 GHz is:

$$\text{CAL. } F = K = \frac{\text{Actual Pwr. Density}}{\text{Indicated Pwr. Density}}$$

Determination of this calibration factor is based upon the expression:

$$P_T = \frac{P_D R^2 \lambda^2}{A_e}, \text{ where:}$$

P_T = Power supplied to transmitting antenna in mw;
P_D = Power density at Radiation Monitor in mw/cm^2;
R = Distance in cm between transmitting antenna and Monitor;
and A_e = Effective area of transmitting antenna.

If $A_e = \frac{G\lambda^2}{4\pi}$; then $P_T = \frac{P_D R^2 4\pi}{G}$

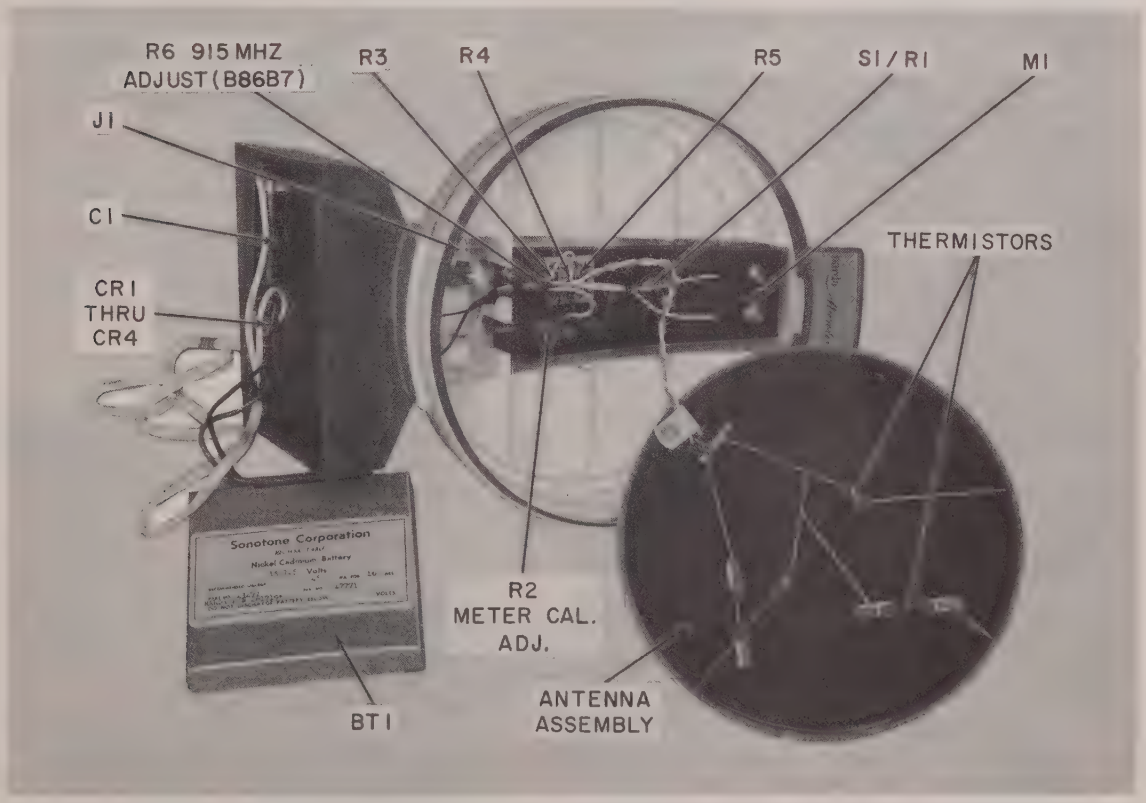


Figure 4-1. Radiation Monitor Internal View

4-12. The value P_T must be calculated for a power density of 2 mw/cm^2 and a distance R of 47" or 119.38 cm for each of the transmitting antennas at the respective frequencies of calibration. All instruments are tested with transmitted power being swept ±50 MHz about the test frequency at a nominal 50 Hz rate. Transmitted power is not swept when testing Model B86B7.

4-13. Calibration Test Procedure for Model B86B3 at Frequencies Above 2.0 GHz. (See figures 4-2 through 4-4.) Perform the calibration procedure at frequencies above 2.0 GHz as follows:

a. Remove four (4) screws securing bottom pedestal plate to instrument.

b. Remove battery (do not disconnect) to gain access to adjustment holes through pedestal bottom and set Meter Calibration Adjust potentiometer R2 fully counterclockwise. (See figure 4-1.)

c. Using test setup shown in figure 4-4 position Monitor in Anechoic chamber at distance of 47" from transmitting horn. Make certain that center-line of transmitting horn and center-line of Monitor antenna are at equal heights.

d. Connect external remote-reading null meter to Monitor Recorder Output jack J1 in series with the precision decade resistance box.

e. Set Monitor On-Off-Zero control knob to On position and set r-f signal source to 10.0 GHz. Set proper sweep bandwidth of ±50 MHz at 50 Hz rate.

f. Transmit theoretical power P_T for 2 mw/cm^2 at a distance of 47". (Refer to paragraph 4-11.)

g. Adjust decade resistance value to obtain a null meter reading of 2 mw/cm^2. Record decade resistance value.

h. Set r-f signal source to 11.0 GHz and repeat steps f. and g. If decade resistance is greater than that recorded in step g., reset resistance value to value of step g. If resistance value is less than that recorded in step g., maintain this resistance value.

i. Remove Monitor from Anechoic Chamber; adjust Zero control R1 for a meter indication of 20 mw/cm^2.

j. Set decade resistance value to zero (0) ohms. Adjust Meter Calibration Adjust potentiometer R2 to restore 20 mw/cm^2 indication on external null meter.

k. Using appropriate test setup shown on figures 4-2 through 4-4, measure incident and reflected power to transmitting horn for each test frequency between 2.0 and 12.4 GHz, as listed in paragraph 4-8, to obtain a power density meter indication of 2 mw/cm^2.

l. Calculate actual power transmitted by the formula.

$P_{T_a} = P_{T_1} - P_{T_R}$, where;

P_{T_1} = incident power at transmitting horn, and

P_{T_R} = reflected power at transmitting horn.

m. Calculate calibration factor at each frequency equal to $\frac{P_{T_a}}{P_T}$ = Calibration Factor.

4-14. Calibration Test Procedure for Model B86B3 at Frequencies Below 2.0 GHz. (See figures 4-5 and 4-6.) Perform the calibration procedure at frequencies below 2.0 GHz as follows:

NOTE

For these tests, three calibrated Monitors must be used and calibrations performed on a comparison basis.

a. Position one of the calibrated Monitors in the chamber and adjust the power output from the transmitting antenna to an arbitrary value which yields a reading of 2 mw/cm^2.

b. Replace first standard Monitor with the other two Monitors, in turn, and record readings of these three standards. Readjust power output for average indication of three standards.

c. Place Monitor under test in chamber and record meter reading.

d. Calculate actual power transmitted using formula in paragraph 4-13 step l.

e. Calculate calibration factor using formula in paragraph 4-13 step m.

f. Repeat steps a. through e., for each calibration frequency under 2.0 GHz, and using the correct test setup as shown in figures 4-5 and 4-6.

4-15. Calibration Test Procedure for Model B86B7 at 2450 MHz. (See figure 4-2.) Perform the calibration procedure at 2450 MHz as follows:

a. Set Frequency Select switch on Monitor to 2450 MHz position.

b. Repeat steps a. through d., of paragraph 4-13, except use test setup in figure 4-2.

c. Calculate transmitted power P_T for 2 mw/cm^2 at a distance of 47" as outlined in paragraph 4-11.

d. Set Monitor On-Off/Zero control knob to ON position and transmit theoretical power P_T calculated in step c.

e. Repeat steps g., i., and j. of paragraph 4-13.

4-16. Calibration Test Procedure for Model B86B7 at 915 MHz. (See figure 4-5.) Perform the calibration procedure at 915 MHz as follows:

a. Repeat steps a. and b. of paragraph 4-14.

b. Set Frequency Select switch on Monitor under test to 915 MHz position.

c. Repeat steps a. through d. of paragraph 4-13, except set 915 MHz Adjust potentiometer R6 fully counterclockwise and reference test setup in figure 4-5 for distance of 32".

d. Transmit power established for average reading of 2 mw/cm^2 on standard Monitors.

e. Repeat steps g., i., and j. of paragraph 4-13 except adjust 915 MHz Adjust potentiometer R6.

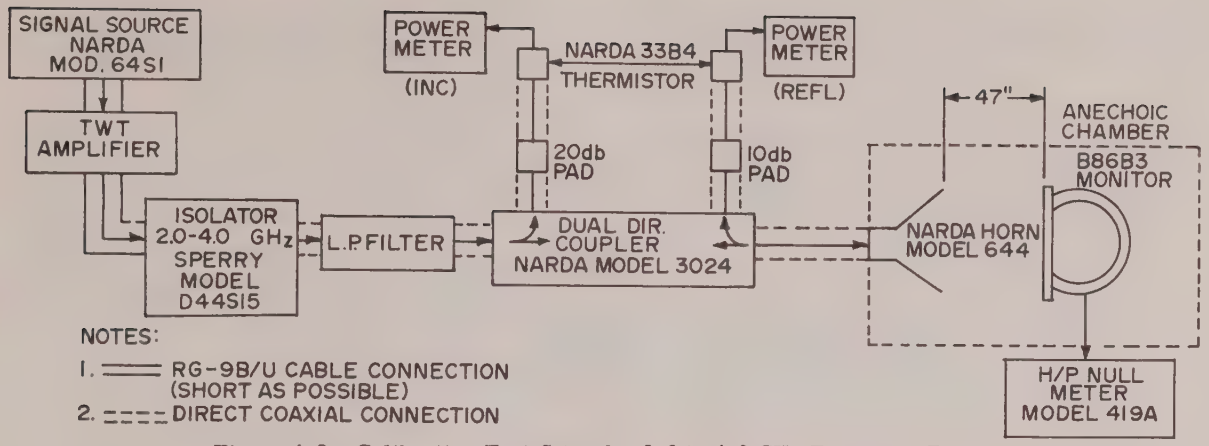


Figure 4-2. Calibration Test Setup for 2.0 to 4.0 GH_Z Frequency Range

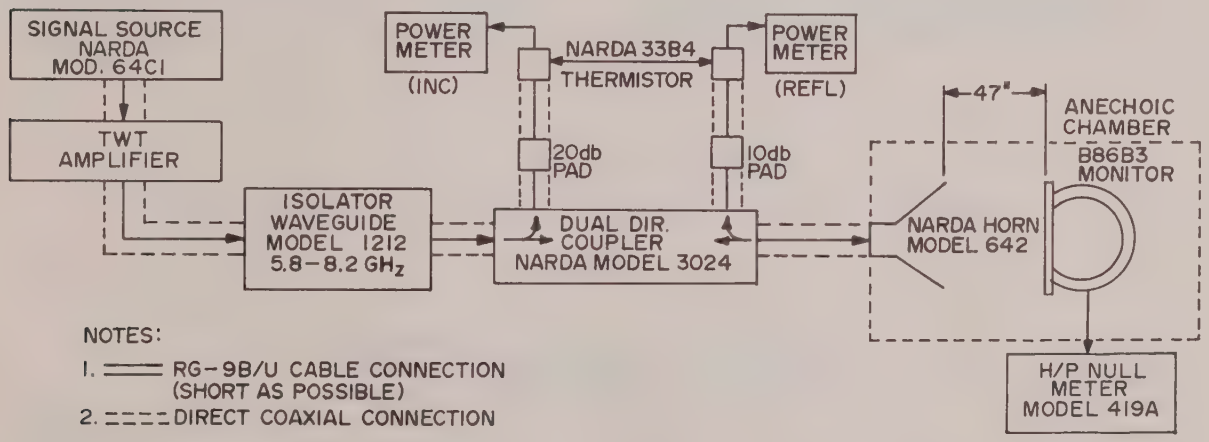


Figure 4-3. Calibration Test Setup for 5.4 to 8.0 GH_Z Frequency Range

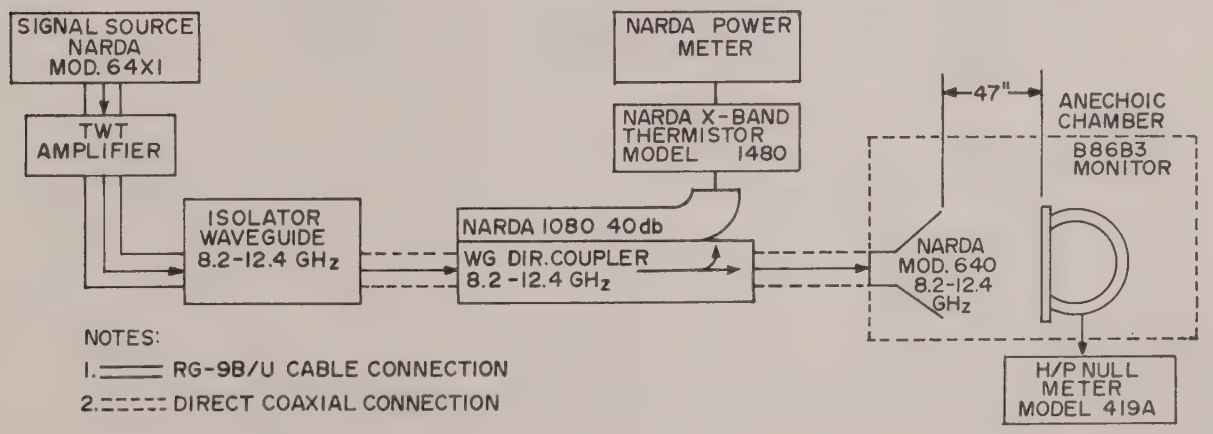


Figure 4-4. Calibration Test Setup for 8.2 to 12.4 GH_Z Frequency Range

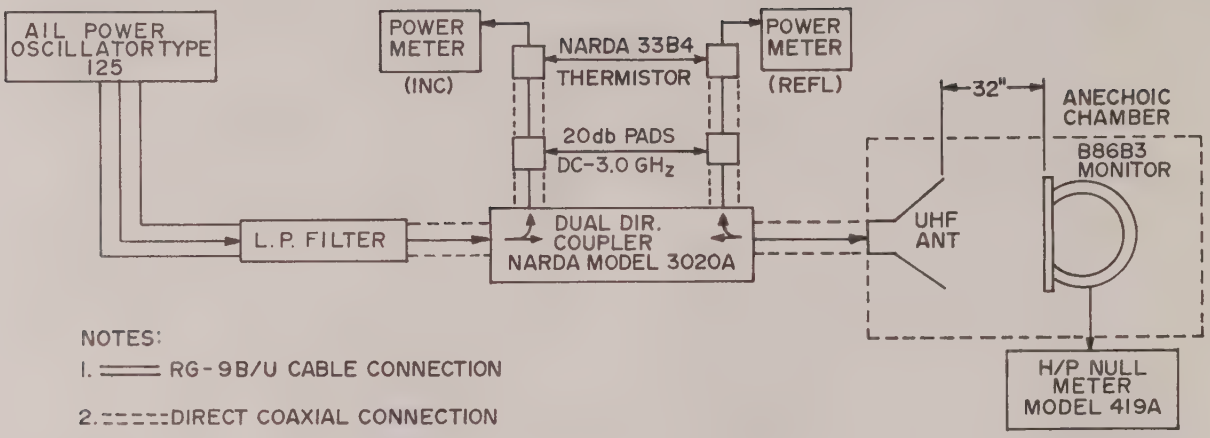


Figure 4-5. Calibration Test Setup for 500 MH_Z to 1.0 GH_Z Frequency Range

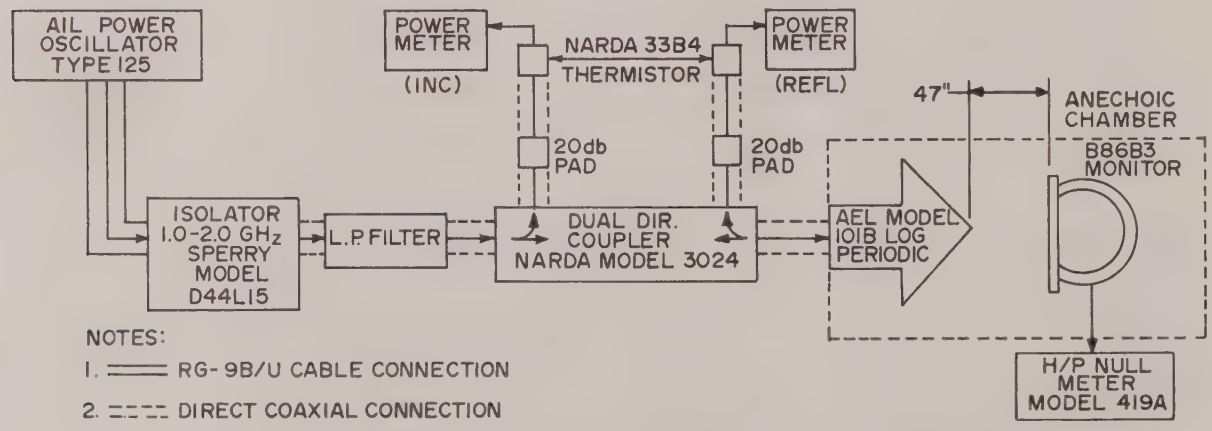


Figure 4-6. Calibration Test Setup for 1.0 to 2.0 GH_Z Frequency Range

4-17. Battery Charge Current Check. Perform a battery charge current check as follows:

a. Set combination On-Off/Zero control to Off position.

b. Remove four (4) screws securing bottom pedestal plate to instrument and remove plate.

c. Disconnect one terminal of battery connector from battery and connect the Simpson 260 in series with the other battery terminal and battery connector terminal.

d. Set up Simpson 260 for dc current indication, and plug instrument line cord plug into 110-volt, 60 H_Z line voltage outlet. The dc meter should indicate a nominal 35 ma charging current.

4-18. TROUBLESHOOTING PROCEDURES.

4-19. A definite indication of trouble in the Monitor is apparent when the meter cannot be properly zeroed and/or the reading drifts. Usually, if the meter cannot be zeroed it indicates that the battery requires recharging. If, after the battery is charged, the meter still cannot be zeroed, or if the reading drifts, it is possible that one or more of the antenna thermistor elements have opened up.

CAUTION

If the batteries are fully charged and the trouble is localized to the antenna assembly, do not disassemble the antenna unless the user is prepared to recalibrate the instrument after replacing the antenna thermistor assembly. This assembly is not repairable in the field and should be returned to the factory. In addition, it is advisable to return the entire instrument to the factory for repair and recalibration, due to the complexity of the calibration test procedure.

4-20. Troubles localized to the battery charging circuit in the pedestal base are readily repaired after removing the base plate to expose the bridge rectifier diodes, capacitor and battery. (See figure 4-1.)

SECTION V

PARTS LIST

5-1. GENERAL.

5-2. This section provides a listing of the replaceable parts of the Monitor. The listing contains the necessary information for the ordering of replacement parts. Parts are listed in alpha-numerical order of their reference designators in accordance with the designators assigned to these parts in the schematic diagrams included in this manual. Part nomenclature, with descriptive data for ordering purposes, are provided along with the Narda part number of each part. The replaceable parts list is presented in table 5-1.

5-3. ORDERING INFORMATION.

5-4. If it is desired to order replacement parts from the instrument manufacturer, address the order to:

SALES DEPARTMENT
The Narda Microwave Corporation
Plainview, L.I., New York

5-5. When ordering a part in this manner, the following information should be provided.
a. Model and serial number of the instrument
b. Narda part number
c. Reference designation
d. Description.

5-6. When ordering a part not listed in table 5-1, a complete description of the part, including its function and location, should be provided with the model and serial number of the instrument.

5-7. CUSTOMER REPAIR SERVICE.

5-8. Repairs or recalibration of Narda Microline products are performed by the Customer Service Department at the factory; however, before returning any instrument, contact the Narda Microwave Corporation or the Narda Sales Representative in the area for shipping instructions. When requesting maintenance, complete the form provided at the rear of this manual.

Table 5-1. Replaceable Parts List

Reference Designation	Description	Narda Part No.	Qty.
BT1	BATTERY: Nickel-Cadmium, 15V	2617195	1
C1	CAPACITOR: 1.0 ufd, ±20%, 400V	-	1
CR1	DIODE: 1N645	2601031	4
CR2	Same as CR1		
CR3	Same as CR1		
CR4	Same as CR1		
J1	JACK: Phone	2601036	1
M1	METER: 0-1 Ma, ±3%, 50 mw	2652103	1
P1	CORD: Power, with plug	2601033	1
R1	RESISTOR: Variable, 500 Ω, ±10%, 1W	2616718-3	1
R2	RESISTOR: Variable, 500 Ω, ±20%, 1/3W	83007-35	1
R3	RESISTOR: Fixed, composition, 1K, ±5%, 1/2W	-	2
R4	Same as R3		
R5	RESISTOR: Fixed, composition, 300 Ω, ±5%, 1/2W	-	1
R6	Same as R2 (B86B7 only)		
S1	SWITCH: SPDT, 120V, 3A	2616718	1
S2	SWITCH: SPDT (B86B7 only)	-	1
-	ANTENNA ASSY	2677628	1
-	ANTENNA COVER	2653973	1
-	RING, RETAINING	2616717	1

narda Microline

THE NARDA MICROWAVE CORPORATION PLAINVIEW, L.I., NEW YORK 11803
516 · 433 · 9000

REQUEST FOR MAINTENANCE

FROM:

COMPANY _____ DATE _____

ADDRESS _____ NAME _____

_____ TITLE _____

DIVISION _____ TELEPHONE _____ EXT_____

_____

EQUIPMENT _____

MODEL _____ SER _____

REASON FOR REQUEST:

☐ Recalibration

☐ Unit not functioning properly

If for repair, describe trouble _____

_____

_____

_____

_____

_____

Is trouble localized? _____

If so, how and where? _____

_____

_____

_____

_____

_____

_____

_____

Is trouble intermittent? _____

Approximate hours of operation prior to failure _____

Date of failure _____

Was factory consulted by telephone or letter prior to this request? _____

If so, give date and name of person to whom directed _____

_____

_____

Additional Comments: _____

_____

_____

_____

_____

_____

_____

_____

When failure occurs requiring factory assistance, complete this form and send to:

The Narda Microwave Corporation
Plainview, L. I., New York 11803
ATTENTION: CUSTOMER SERVICE DEPARTMENT

After this request has been reviewed by the Customer Service Department, you will be contacted by the Company or the Sales Representative in your area. If it is required to ship the equipment back to the factory, we will notify you with instructions and authorization for returning the equipment.

NO EQUIPMENT MAY BE RETURNED TO THE FACTORY WITHOUT WRITTEN AUTHORIZATION.